

## CLAIMS

### WE CLAIM:

1. A method of monitoring a structure comprising:  
attaching a plurality of laterally adjacent conductors to the structure;  
defining each conductor of the plurality to include a plurality of segments coupled in series, each segment having an associated unit value representative of a defined energy transmitting characteristic;  
defining a plurality of identity groups, each identity group including a plurality of laterally adjacent segments wherein each identity group includes at least one segment from each of the plurality of conductors;  
transmitting energy through each of the plurality of conductors;  
monitoring each of the plurality of conductors for changes in the defined energy transmitting characteristic;  
comparing a first change in the defined energy transmitting characteristic in at least one conductor of the plurality with a second change in the defined energy transmitting characteristic in at least one other conductor of the plurality.
2. The method according to claim 1, further comprising determining a specific identity group from which the first change in the defined energy transmitting characteristic and second change in the defined energy transmitting characteristic were initiated.
3. The method according to claim 2, wherein determining a specific identity group includes determining a ratio of the first change in the defined energy transmitting characteristic with respect to the second change in the defined energy transmitting characteristic.
4. The method according to claim 3, wherein determining a specific identity group further includes comparing the ratio of the first and second changes in the defined energy transmitting characteristic to a plurality of predetermined ratios, wherein the plurality of predetermined ratios includes ratios of unit values of the plurality of laterally adjacent segments within each of the plurality of identity groups.

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5. The method according to claim 2, further comprising comparing the first change in the defined energy transmitting characteristic with the unit value for the segment which is both located with the specific identity group and formed in the at least one conductor.

6. The method according to claim 5, further comprising comparing the second change in the defined energy transmitting characteristic with the unit value for the segment which is both located with the specific identity group and formed in the at least one other conductor.

7. The method according to claim 1, wherein defining a plurality of identity groups includes assigning the unit values to each of the plurality of laterally adjacent segments of each identity group such that each identity group may be identified by a concatenated digit string representative of the unit values contained therein.

8. The method according to claim 7, wherein defining a plurality of identity groups further includes assigning the unit values to each of the plurality of laterally adjacent segments of a given identity group such that each of a plurality of ratios of the unit values assigned to the plurality of segments within the given identity group is unique.

9. The method according to claim 7, wherein defining a plurality of identity groups includes assigning the unit values to each of the plurality of laterally adjacent segments of a given identity group such that the concatenated digit string is a prime number.

10. The method according to claim 1, wherein attaching the plurality of conductors to a structure includes forming a plurality of conductive traces on a surface of the structure.

11. The method according to claim 10, wherein the forming a plurality of conductive traces on a surface of the structure includes thermally spraying the conductive traces on the surface of the structure.

12. The method according to claim 11, wherein attaching the plurality of conductors to a structure further includes spraying a layer of insulative material on a surface of the structure and forming the plurality of conductive traces over the layer of insulative material.

13. The method according to claim 10, wherein defining each conductor of the plurality to include a plurality of segments includes defining a plurality of resistance segments and further comprising defining the unit value of each resistance segment to be representative of a unit resistance value.

14. The method of claim 13, wherein monitoring the plurality of conductors for a change in the defined energy transmitting characteristic includes measuring resistance across each conductor of the plurality under no-load conditions to establish a baseline value for each conductor and detecting a variance from the base line value.

15. The method of claim 14, wherein monitoring the plurality of conductors for a change in resistance further includes setting a new baseline value for each conductor after detecting the variance.

16. The method of claim 1, wherein monitoring the plurality of conductors for a change in the defined energy transmitting characteristic includes measuring the defined energy transmitting characteristic across each conductor of the plurality under no-load conditions to establish a baseline value for each conductor and detecting a variance from the base line value.

17. The method of claim 16, wherein monitoring the plurality of conductors for a change in the defined energy transmitting characteristic further includes setting a new baseline value for each conductor after detecting the variance.

18. The method according to claim 1, wherein monitoring the plurality of conductors for a change in the defined energy transmitting characteristic includes monitoring at a sample rate of approximately once per second.

19. The method according to claim 1, wherein the transmitting energy through each of the plurality of conductors includes inducing an electrical current in the plurality of conductors.

20. A method of monitoring strain induced within a structure, the method comprising: attaching a plurality of laterally adjacent conductors to the structure such that a strain exhibited by the structure will be substantially transferred to the plurality of conductors; defining each conductor of the plurality to include a plurality of resistance segments, each resistance segment exhibiting an associated unit resistance value and each of the plurality of conductors being configured to exhibit a change in resistivity upon experiencing a strain therein; defining a plurality of identity groups, each identity group including a plurality of laterally adjacent resistance segments wherein each identity group includes at least one resistance segment from each of the plurality of conductors; transmitting energy through each of the plurality of conductors; monitoring the plurality of conductors for changes in resistance therein; comparing a first change in resistance in at least one conductor of the plurality with a second change of resistance in at least one other conductor of the plurality.

21. The method according to claim 20, further comprising locating a situs of the strain exhibited by the structure by identifying the specific identity group from which the first change in resistance and the second change in resistance were initiated.

22. The method according to claim 21, wherein identifying a specific identity group includes comparing a ratio of the first change in resistance with respect to the second change in resistance to a plurality of predetermined ratios, each of the plurality of predetermined ratios being associated with a one of the plurality of identity groups.

23. The method according to claim 22, further comprising determining a magnitude of the strain exhibited by the structure by comparing the first change of resistance to the

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associated unit resistance value of the resistance segment which is both located in the specific identity group and formed in the at least one conductor.

24. The method according to claim 20, further comprising at least partially defining the associated unit resistance to each resistance segment of the plurality by defining the cross-sectional area of each resistance segment .

25. The method according to claim 20, further comprising at least partially defining the associated unit resistance of each resistance segment by defining the porosity of each resistance segment.

26. The method according to claim 20, further comprising at least partially defining the associated unit resistance segment by selecting the material composition of each resistance segment.

27. The method according to claim 20, further comprising identifying each identity group with a concatenated digit string representative of the associated unit resistance values of each resistance segment contained therein.

28. The method according to claim 27, further comprising assigning the associated unit resistance of each resistance segment of each identity group such that each concatenated digit string is a prime number.

29. A system for detecting physical phenomena in a structure comprising:  
a plurality of laterally adjacent conductors, each conductor including a plurality of segments having an associated unit value representative of a defined energy transmission characteristic;  
a plurality of identity groups, each identity group including a plurality of laterally adjacent segments including at least one segment from each conductor, wherein each segment within an identity group exhibits an associated unit value such that the unit values of each identity group may be represented by a concatenated digit string of the unit values and

wherein each identity group exhibits a unique concatenated digit string relative to each other identity group.

30. The system of claim 29, wherein each concatenated digit string is representative of a prime number.

31. The system of claim 29, wherein the plurality of conductors is configured to be attached to the surface of a structure.

32. The system of claim 29, wherein each segment is configured to exhibit a change in the defined energy transmission characteristic upon experiencing a strain therein.

33. The system of claim 29, wherein a plurality of ratios are defined between the associated values of each segment of a given identity group and each other segment of the given identity group and wherein each of the plurality of ratios within the given identity group are unique.

34. The system of claim 29, wherein the plurality of conductors comprises a plurality of conductive traces.

35. The system of claim 29, wherein the associated unit value of each of the plurality of segments corresponds to a cross-sectional area exhibited thereby.

36. The system of claim 29, wherein the associated unit value of each of the plurality of segments corresponds to a material porosity thereof.

37. The system of claim 29, wherein the associated unit value of each of the plurality of segments corresponds to a material composition thereof.

38. The system of claim 29, wherein each segment comprises a length of approximately twenty feet.

39. The system of claim 29, wherein each conductor comprises a length of approximately twenty miles.

40. The system of claim 29, wherein the plurality of conductors includes at least five conductors.

41. A structure comprising:  
at least one structural member;  
a plurality of conductors attached to the at least one structural member, each conductor of the plurality including a plurality of segments coupled in series;  
a plurality of identity groups, each identity group including a plurality of laterally adjacent segments including at least one segment from each conductor, wherein each segment within an identity group exhibits an associated unit value representative of a defined energy transmission characteristic such that the unit values of each identity group may be represented by a concatenated digit string of the unit values contained therein and wherein the concatenated digit string of each identity group of the plurality is unique.

42. The structure of claim 41, wherein the at least one structural member comprises at least one conduit for conveying a fluid medium and wherein the plurality of conductors are attached to an interior surface of the at least one conduit.

43. The structure of claim 42, wherein the plurality of conductors includes conductive traces and wherein each conductive trace is insulated from each other conductive trace.

44. The structure of claim 42, wherein each of the plurality of conductors comprises a length of approximately twenty miles.

45. The structure of claim 42, wherein the each of the plurality of segments comprises a length of approximately twenty feet.

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46. The structure of claim 41, wherein each of the plurality of conductors includes a thermally sprayed conductive trace comprising a nickel aluminum alloy.

47. The pipeline of claim 43, further comprising a layer of thermally sprayed alumina disposed between each conductive trace and a surface of the at least one structural member.

48. A pipeline comprising:  
at least one conduit configured to convey a fluid medium therethrough; and  
at least one conductive trace formed along an interior surface of the at least one conduit.

49. The pipeline of claim 48, further comprising at least one sensor operatively coupled with the at least one conductive trace.

50. The pipeline of claim 49, further comprising an insulative layer between the at least one conductive trace and the interior surface of the at least one conduit.

51. The pipeline of claim 50, further comprising at least one bonding layer between the insulative layer and the interior surface of the at least one conduit.

52. The pipeline of claim 50, wherein the interior surface of the at least one conduit includes a degraded surface.

53. The pipeline of claim 48, wherein the at least one conduit and the at least one conductive trace extend coextensively for a distance of at least approximately one mile.

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